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The Standley Allotment: A History of Range Recovery

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Metric Equivalents

1 mile (mi) = 1.61 kilometers (km)
1 foot (ft) = 0.3048 meter (m)
1 inch (in) = 2.54 centimeters (cm)
1 square foot (ft^2) = 0.0929 square meter (m^2)
1 acre = 0.4047 hectare (ha)
Degrees Fahrenheit (°F) = 1.8 degrees Celsius (°C) + 32°

Cover photo: A sheep camp and bedground on the Standley allotment, 1907.

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Reference Abstract

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One of the first range research programs on National Forest lands was conducted by Dr. Arthur W. Sampson in the Wallowa Mountains, Oregon, between 1907 and 1911. This paper reviews the historical perspective of and the basic range management principles and practices developed from Sampson's studies as well as the land and grazing management of the study area to 1980. Plant succession and range improvement from the depleted conditions prevalent in 1907 are discussed and documented by photographs between 1955 and 1976.

Keywords: Range management, history (range research), revegetation (range) succession, subalpine ranges, *Festuca viridula*, grazing damage.

Research Summary

Between 1907 and 1911, Dr. Arthur W. Sampson conducted one of the Forest Service's first range research programs on the subalpine grasslands of the Standley allotment in the Wallowa Mountains of eastern Oregon. Excessive grazing by sheep, beginning about 1880, had resulted in severe deterioration of vegetation, soil, and watershed resources. Only remnants remained of the once dominant green fescue, an important forage grass. Much of the grassland was eroding and barren. Sampson recorded these conditions and his experimental studies with photographs.

Where sufficient green fescue plants remained, Sampson deemed it possible to restore the productivity of the grasslands through natural reseeding. His 1st-year study of the seedling ecology of major species suggested that a deferred grazing system would allow the fescue to flower, set seed, and become established in the depleted communities. Three areas of the Standley allotment, those in the poorest condition, were set aside and grazed the last fifth of the grazing season for 4 years. Sampson studied and compared their recovery with that of other areas, both protected and grazed season-long.

The deferred grazing system worked well. Green fescue seedlings became established and matured, range condition had improved, and it was not disadvantageous to sheep. Similar deferred systems were used on several allotments in the Wallowa Mountains, and Sampson recommended their use on other badly depleted ranges in the Western United States.

On barren sites where natural revegetation was unlikely, Sampson conducted a 5-year study of reseeding with introduced grasses. As part of a more extensive study in the Western United States, his objective in the Wallowa Mountains was not only to restore productivity but also to determine either the factors necessary to insure seeding success or the reasons for failure on subalpine sites. He experimented with planting methods and spring and fall seeding and observed the growth and adaptability of the seeded species. The seedlings were successful; however, their long-term survival in the subalpine environment seemed unlikely. Sampson published some reseeding guidelines based on this work; the guidelines are still used.

As a result of Sampson's work, livestock numbers were reduced on the range and various land and livestock management practices, including deferred grazing and non-use, were initiated to promote recovery of the range.

Between 1955 and 1976, quadrat studies were made and photographs were retaken to record and illustrate the recovery of vegetation. In 1976, vegetation cover had greatly increased (to 60 percent), and green fescue had regained or shared dominance where sufficient topsoil, uneroded or in remnant pedestals, had remained in 1907. Sites that had been severely eroded or barren in 1907, showed variable recovery. Some had a fair to good cover (to 40 percent) of vegetation dominated by secondary species; green fescue cover has only recently begun to increase in these communities. Other sites barren in 1907 remained in that condition because of their location, continued overgrazing, or because frost heave and summer drought prevented establishment of seedlings. Where Sampson reseeded introduced species, only native species were found. Cover was fair (30 to 40 percent), and both secondary species and green fescue dominated, the latter where it was present in 1907.

Although recovery since 1907 was apparent, the early depletion of vegetation and soil erosion essentially modified the grassland habitats and regulated the rate and amount of recovery. The plant communities were in a variety of secondary successional stages. No communities had recovered to green fescue climax.

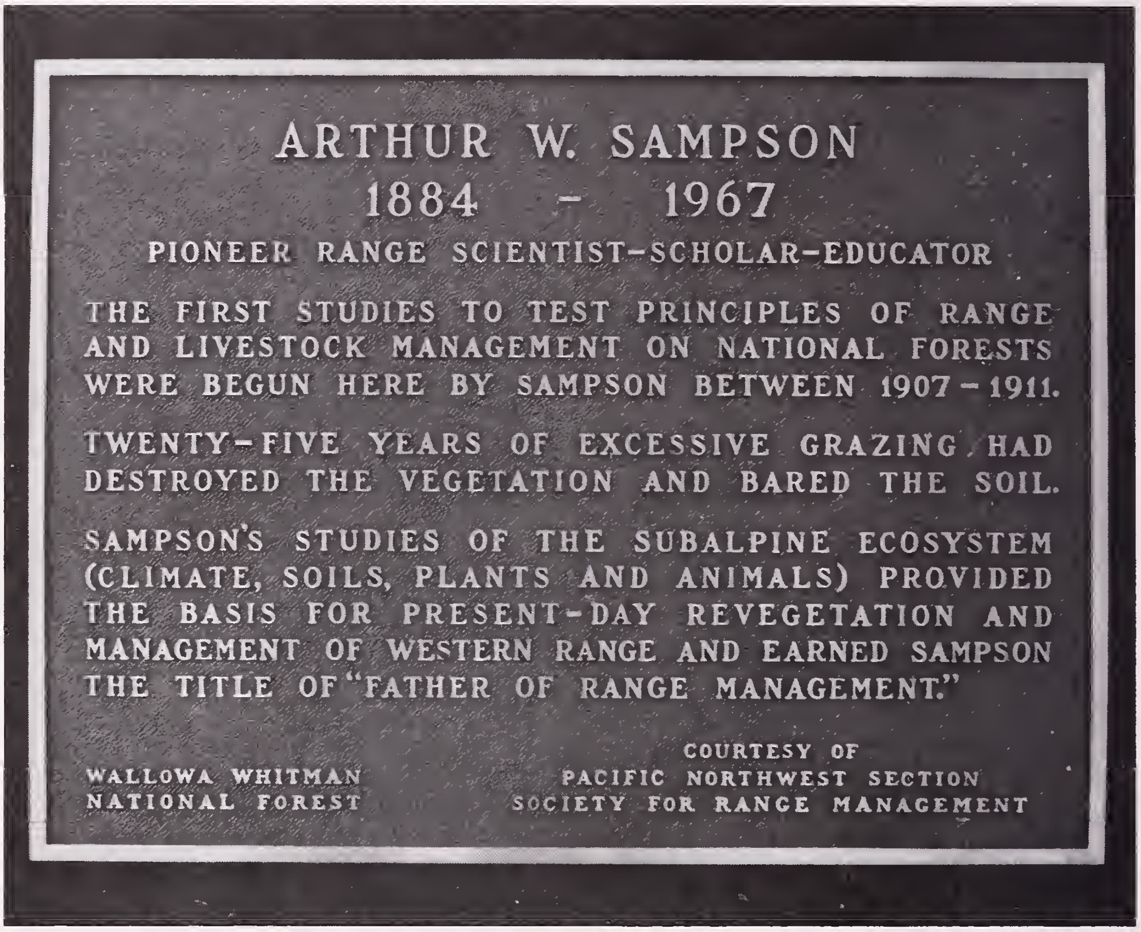
Preface

The Wallowa Mountains in northeast Oregon are an area of rugged scenic beauty well known by hikers, back packers, trail riders, and hunters. The mountains are also important as a watershed to surrounding municipalities and for irrigation and hydroelectric facilities in the lower valleys. Furthermore, they supply abundant habitat and summer grazing for game animals, particularly deer and elk, and for domestic livestock.

Watershed and range conditions in the Wallowa Mountains, however, were poor in 1900. The scene was one of deterioration caused by 20 years of excessive grazing by domestic cattle and sheep. Dr. Arthur W. Sampson, a young ecologist in the Bureau of Plant Industry in Washington, D.C., was sent by the Forest Service in 1907 to determine how to stop the deterioration and improve conditions. The results of his 5-year study of subalpine ranges on the Standley allotment led to early development of many range management principles and practices in use today.

The pioneering work of Arthur Sampson and the subsequent recovery of the ranges provided stimulus for the study reported here. This paper is respectfully dedicated to his memory.

Dr. Sampson, who died on February 7, 1967, was honored on July 29, 1976, by the dedication of a plaque on a stone monument overlooking one of his research areas near Standley Spring.



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CP = camera points.

Introduction

The Standley allotment in Oregon's Wallowa Mountains (fig. 1) looms large in the history of rangeland research and management in the Western United States. It was in the subalpine grasslands of this grazing allotment in the early 1900's that Dr. Arthur W. Sampson[1] began one of the first research programs on National Forest lands to test new ideas and principles of range management.

In the Wallowas, as in many parts of the West, excessive grazing by domestic sheep and cattle had damaged or were damaging the ranges almost beyond repair. Soil erosion was extensive, and the desirable forage plants were greatly reduced or, in some areas, eliminated. Parts of the range had become "practically valueless for grazing purposes" (Sampson 1908, p.7). Information on proper management of these grasslands was needed to restore vegetative cover and productivity for both watershed protection and livestock forage.

Sampson's studies on the Standley allotment between 1907 and 1911 not only provided guidelines for restoration of subalpine grasslands but also provided significant contributions to the infant science of range management. He continued his research on subalpine ranges in Utah and subsequently taught range ecology and management at the University of California, Berkeley. For more than 50 years, in his many papers and textbooks, he often used the research results and photographs from the Wallowa Mountains to emphasize stages of plant succession and range deterioration and improvement.

[1] Sampson is briefly identified in the preface. For a detailed account of Dr. Sampson's life and work, read the biography (Parker et al. 1967) prepared by his close friends, associates, and former students following his death.

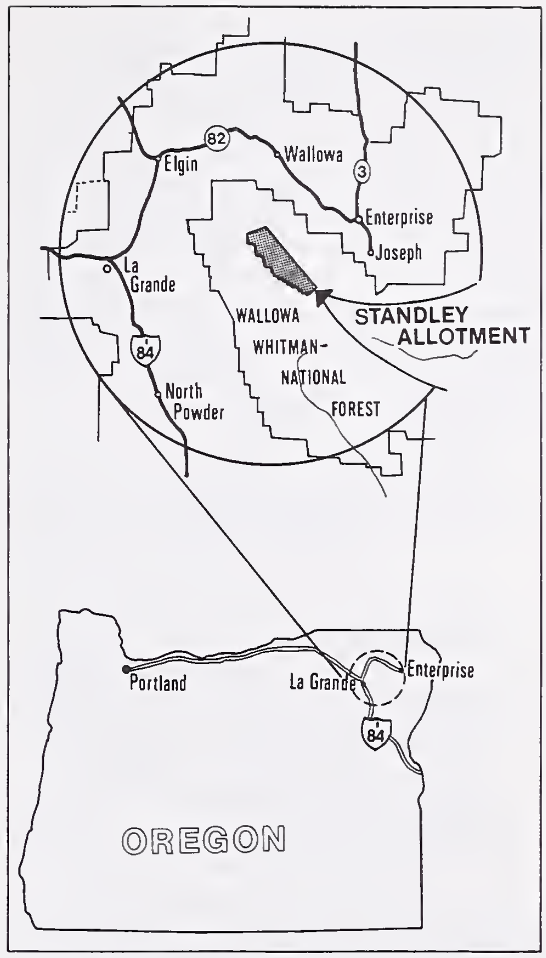

Figure 1. *The Standley allotment in northeast Oregon.*

Sampson revisited the Standley allotment in 1955, at age 71, to observe the changes that had taken place. Some sites visible in six original photographs were rephotographed and notes were made on the presence and amount of plant species. We continued this process intermittently until 1976. During this time, 10 more of the original photograph sites were located and rephotographed. The photograph series, and the accompanying plant data, provide the basis for this paper, which is a story of Sampson's studies between 1907 and 1911, and the changes and recovery observed between 1955 and 1976, 48-69 years later. Unfortunately, Sampson's original quadrat data have been lost, and his assessment of the recovery he observed in 1955 was not recorded. We therefore make use of data and photograph captions available in his reports, manuscripts, and publications of the early studies, and the notes taken by those who accompanied him in 1955. We often quote from his early papers to narrate the story.

Need for Research

The grazing capacity of Western mountain rangelands was seriously depleted by 1907 as a result of overstocking during the "free-for-all" (Sampson 1913a, p.2) grazing period that followed settlement in the mid-1800's. Sheep and cattle had repeatedly removed most of the plant growth early in the growing season year after year. This lowered the vitality of the plants and their ability to produce viable seed (Sampson 1913a).

In 1889 a preservationist group, led by John Muir, pressed for complete closure of the high mountain lands in the Pacific Northwest to sheep use (Wolfe 1945). The group not only deplored the damage to vegetation by sheep and the subsequent deterioration of the watersheds but also considered sheep to be a blight on the landscape. But convervationists, later including Gifford Pinchot, considered such closures impractical from the standpoint of the livestock industry and thought that the grazing lands could be improved if brought under governmental management (Nash 1973, Rakestraw 1958).

At the request of the preservationist group, 4.5 million acres along the Cascade Range were set aside in 1893 as Forest Reserves and closed to sheep grazing. Pressure by stockmen soon reinstated sheep use, yet, following an 1897 study of range conditions in the Cascade Reserve (Colville 1898), it was evident that regulation of grazing would be necessary. In 1899, the stockmen and forest officials decided to begin a permit system; individual owners would graze designated range allotments and would be charged a fee of $5 per 1,000 head (Rakestraw 1958). But range conditions continued to decline because of sheep numbers (2,500,000 in Oregon in 1897) and improper management of land and livestock.

Study Areas

These controversies and actions were closely followed by stockmen who used the high mountain summer ranges in northeastern Oregon. In contrast to the Cascade Reserve, this area was still public domain and had a longer history of uncontrolled grazing (Colville 1898). The grazier who got there first got the forage. The result of such exploitation was the continuing decline in sheep numbers. Many ranges were

> ...so much reduced in carrying capacity that they have been rendered practically valueless for grazing purposes, and the original palatable plants...have been succeeded by weedy annuals or by perennial species that are of little or no forage value (Sampson 1908, p. 7).

In 1901 Oregon stockmen endorsed the proposed establishment of the Forest Reserves in northeast Oregon (Minto 1902); they were beginning to accept the fact that range forage was limited and that some regulation of grazing similar to that done in the Cascade Reserve would be to their interest if carrying capacities were to be increased. As Sampson stated,

> Owing to the great importance of the summer range to the grazing industry in this community,... [the Wallowa National Forest]... the question of range improvement was strongly agitated by stockmen. Finally the Government was called upon to make a critical study of the ranges and gather such information as might be of value in finding some practical means of improving the existing conditions (Sampson 1908, p. 7-8).

When Sampson arrived in the Wallowas in the spring of 1907, he had these objectives: (1) continue research in reseeding cultivated forage plants on "grazed-out" areas, (2) study the ecology of the native forage plants and plant communities of the major summer range types, and (3) from these studies, develop grazing systems that would improve range condition. Because the green fescue[2] grasslands in the Hudzonian or whitebark pine zone[3] supported

> ...most of the sheep permitted in the Wallowa Forest during the summer growing season...[and] ...on account of the demands made upon this desirable range and because of the character of the forage, the Hudzonian zone has suffered more serious depletion than any other, and it was here that the most intensive study of revegetation was made (Sampson 1914, p. 96).

Sampson selected two subalpine grasslands for intensive study, one near Standley Spring and the other in Sturgill Basin. They were on the Standley allotment which is now located in the northwestern portion of the Eagle Cap Wilderness. Wilderness lands became the center of the summer sheep range in the 1880's with large introductions and buildup of sheep numbers (Wentworth 1948). By the mid-1890's, several hundred-thousand sheep and cattle followed the melting snow to the high summer range and stayed there until snowed-out in late September. Range deterioration eventually forced a reduction in sheep numbers; only 252,000 ewes with lambs were permitted to graze on the newly established Wallowa National Forest in 1906 and 166,000 in 1907,[4] the year Sampson began his studies.

[2] Scientific names are listed in the appendix.

[3] Sampson's Hudzonian or whitebark pine zone (Sampson 1909, p. 9-10) equates with the subalpine fir zone (Franklin and Dyrness 1973).

[4] Tucker, Gerald J. 1955. A history of the Wallowa National Forest. 286 p. Unpublished manuscript on file at Range and Wildlife Habitat Laboratory, La Grande, Oregon.

Livestock use on Standley allotment (and the two study sites) before 1911 is unknown but discussions with old timers indicated that the allotment was heavily grazed by both sheep and cattle prior to the establishment of the Wallowa National Forest in 1905. The known graziers (William Sherod, J.D. Standley, J.H. Dobbin, George Schaut, and John Goebel) annually grazed about 1,000 head of cattle and 10,000 ewes on the allotment. They followed the common practice where ranges were first "topped"[5] with the ewe-lamb bands. After the lambs were removed, dry ewe bands went back, regrazed the allotment, and took the remaining herbage. They were kept on the area until the snow drove them out. Although the cattle generally grazed the lower canyon slopes, they often climbed to the subalpine grasslands. This practice produced the depleted range conditions that Sampson observed at Standley Spring and Sturgill Basin in 1907.

The two study sites, 6 miles apart, are large grasslands distinctly subalpine in character and climate at about 7,400 feet. Vegetation is typical of the lower subalpine where spruce-fir and lodgepole pine forests give way to extensive open parklands interspersed with individual trees and patches of subalpine fir, Engelmann spruce, and whitebark pine.

[5] Grazed for just the best forage; i.e., leaves, succulent plants, etc.

The short summer season is cool and dry with 4-6 inches of precipitation during July through September. Winters are long, cold, and wet. The snow, which reaches an average maximum depth of 8 feet,[6] accounts for most of the estimated 40 inches of annual precipitation.

August, the warmest month, has an average daily temperature of 60°F, but daily high and low temperatures can be extreme; Sampson recorded a high temperature of 91°F in 1909 and noted that frosts could occur at anytime. January, the coldest month, has mean daily temperatures of about 18°F.

Wind is an important factor in the subalpine environment. It is commonly more pronounced and constant than at lower elevations, greatly affecting soil and air temperatures, soil moisture, and snow deposition and removal. Thus it strongly influences species composition and distribution of plant communities. On depleted grassland sites, summer winds easily remove or redistribute the dry surface soils.

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[6] Don Baldwin, Soil Conservation Service, Enterprise, Oregon. Personal communication.

The basalt-derived soils of the study area are medium to fine textured and contain loess and volcanic ash that were aerially deposited about 6,000 years ago. This combination of materials forms rich soils with high water holding capacity but which also are friable and loose, characteristics that cause surface layers to dry quickly and erode when the protective plant cover is depleted. Even where topography is gentle, much bare rock is evident. Some rocky areas are a natural phenomenon of the mountain environment, but some became exposed as wind and water removed the surface soil of the depleted grasslands.

Sampson listed plant species that occurred on the depleted grasslands. The most abundant, prior to deterioration, was green fescue which gave "...character to the landscape... [and was]...preeminent in importance among the forage plants of the entire range" (Sampson 1908, p. 10). But this grass had been virtually eliminated and replaced by species better adapted to the eroding soils. Of these, western and little western needlegrass[7] and various sedges were most agressive. Sampson noted that needlegrass planted itself, particularly on barren soils subject to higher daytime temperatures than occurred on vegetated sites. The repeated twisting and untwisting of the awn with alternate drying and wetting pushed the seed into the soil, and the backward-turned hairs on the seed then held it in the soil.

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[7] Little western needlegrass (*Stipa occidentalis* var. *minor*) is commonly mistaken for Letterman needlegrass (*S. lettermanii*) which is also abundant in other green fescue grasslands in the Wallowa Mountains (Reid et al., 1980). Our voucher specimens were identified as *S. occidentalis* var. *minor*, thus all "dwarf" *Stipa* encountered were assumed to be this taxa. Sampson (1914) listed *S. occidentalis* and *S. minor* [sic] in his publications.

Of the sedges, Ross sedge (Sampson's sickle sedge) was particularly abundant:

> ...sickle sedge, a short, wiry weed which is not at all palatable to stock, composed at least nine-tenths of all the seedlings. This plant is very vigorous, has a wide distribution locally, and is adapted to a variety of habitats. It produces an abundance of seeds which matures so early in the season that... [grazing]...does not materially interfere with the seed production, and it perpetuates itself abundantly by offshoots from the rootstalks (Sampson 1908, p. 18).

Of the many forbs, the more common were fernleaf licoriceroot, peregrine fleabane, western yarrow, Cusick speedwell, pokeweed fleeceflower, skyrocket gilia, hairstem groundsmoke, and needleleaf sandwort. These were less preferred as forage, and the ungrazed vigorous plants had flowered, produced abundant seed, and spread over the depleted grasslands. They thus competed for space, nutrients, and moisture with the weakened and continually grazed green fescue.

The Studies: 1907-1911

Natural Revegetation

Sampson determined that it would be essential to study the life cycles of native forage plants if he were to bring about their reestablishment on the depleted grasslands. For this work he constructed small enclosures to compare the reproductive processes of grazed and ungrazed plants. Comparative observations included both the beginning and the period of (1) spring growth, (2) flower-stalk production, (3) seed maturation, viability, and germination, and (4) seedling establishment. Special attention was given to green fescue, but information on all prominent species was needed to determine

> . . . the rate at which plants are invading overgrazed areas, and becoming established on them, the character and composition of this succeeding vegetation, . . . [and] . . . the plants which may eventually predominate under the present conditions . . . (Sampson 1908, p. 12).

Observations were made on 1-m² quadrats. On some, the position of every plant was charted. On others, all vegetation was removed to determine establishment rates of invading species. Sampson followed plant succession on these quadrats for 3 years, simultaneously recording air temperature, humidity, precipitation, soil moisture, and evaporation. He considered these the important climatic factors ". . . which determine the rate of movement, character of grouping, and composition of . . ." the developing plant communities (Sampson 1908, p. 13).

Similar quadrats were established on grazed sites to determine losses from trampling and utilization.

At the end of the 1907 grazing season, Sampson confirmed the fact that green fescue was the most valuable forage plant in the Wallowa Mountains. It was the most abundant, palatable forage plant and was "relished" by sheep throughout the grazing season. Furthermore, his later analysis showed that the mature green fescue had 94 percent more protein and 50 percent less fiber than timothy hay (Sampson 1914).

Sampson also found that seed of green fescue and other important forage plants ripened about September 1, but this date varied considerably because the overgrazed plants had poor vigor. Many plants produced seeds of low viability. Consequently, these plants were not reestablishing themselves on the depleted ranges. Most established seedlings were either annuals, which produced abundant seed, or of Ross sedge and the perennial forbs mentioned previously, or of little western needlegrass, California brome, and slender hairgrass, perennial grasses not ". . . greatly relished by stock . . . [and thus] . . . allowed to go to seed" (Sampson 1908, p. 18). Counts on the grazed quadrats showed that moderate grazing by sheep in late summer had resulted in a 33-percent loss of a sparse stand of current-year seedlings (Sampson 1908). Sampson concluded, however, that if ". . . two-thirds of the seedlings survived in good condition after grazing, ample reproduction is assured" (Sampson 1908, p. 19).

With these results, Sampson began to plan a deferred grazing system to reestablish green fescue, possibly developing his ideas from Cotton's (1905) earlier review of the good points of "alternation" and delaying of grazing in pastures. About one-fifth of the summer grazing season remained after the bulk of the green fescue seed crop had matured. He reasoned that if an area of range having one-fifth of the forage needed for one sheep band were closed to grazing to protect a seed crop, sufficient time would remain after the seed had fallen for the sheep to use the forage and, while grazing, plant the seed by their trampling. Removal of leaf tissue after plants had attained peak growth and food storage would interfere less with plant vigor, growth, and reproduction processes during the following season than would earlier grazing.

Sampson began deferred grazing studies in 1908 on three areas of the Standley allotment—at Standley Spring, Sturgill Basin, and in the adjacent Bear Creek drainage. Seedling studies indicated that the deferred system would have to be repeated on the same areas in 1909 to give the new seedlings an opportunity to develop root systems strong and deep enough to withstand trampling. A 2d-year deferment would also permit development and dissemination of a second seed crop in case the one in 1908 was poor (Sampson 1909).

The 1908 results were not conclusive. Although Sampson's data indicated that 1907 and 1908 were fairly good seed years, practically no viable seed was produced in 1907, and there was only a small seed crop in 1908 (Sampson 1913a). Forage plants were so weakened from past overgrazing that seed production and viability were still low. He concluded that improvement in the forage stand would ". . . not be known until another season . . . [of deferred grazing] . . . has passed" (Sampson 1909, p. 28).

The deferred grazing experiment was continued in 1909 and the following information was collected: (1) comparison of seedling stands on the sites protected, deferred, and grazed season-long, (2) morphological development of different aged seedlings, their moisture requirements, and loss of seedlings in relation to climatic conditions from early spring to fall, (3) the mode of seedling destruction resulting from moderate fall grazing, and (4) the time needed for recuperated forage plants to produce normal, viable seed crops where protected or deferred from grazing.

Green fescue vigor greatly improved inside the ungrazed enclosures. Its cover had increased, primarily by tillering of small plants, and a satisfactory seed crop was produced. But only a few seedlings were established (Sampson 1914). Conversely, he found good seedling establishment on grazed range, and recorded 2-10 times more seedlings of the important forage plants on deferred range than on range grazed season-long. Sampson (1914, p. 105) therefore concluded "...that if the forage crop is left undisturbed until the seed has ripened...it will produce as large and as early a seed crop the following season as will vegetation on range not grazed at all."

Sampson's study of seedlings showed that shallow rooted (2-5 in) 1st-year plants suffered losses from summer drought, competition (where dense), and frost heave in early summer. In addition, 60 percent or more of the remaining seedlings could be lost when fall-grazed under the deferred system. Losses resulted from the sheep's hooves pruning the surface feeding roots or, in wet soils, pressing the plants out of the ground (Sampson 1913b, 1914).

There were fewer losses for 2-year-old plants. These plants escaped surface soil drought in the summer and frost heave in the fall and spring because their roots were more extensive and penetrated deeper. In the third growing season, plants were considered mature and usually produced viable seed (Sampson 1913a).

By the fall of 1909, Sampson had concluded that 3 years of protection were required for badly depleted green fescue plants to produce abundant viable seed. He believed, on the other hand, that green fescue grasslands which retained native forage plants not more than 6 feet apart could be improved through deferred grazing systems (Sampson 1914). Although heavy losses of seedlings did occur under moderate deferred grazing, the remaining seedling stand, the improved vigor, and the increased shoot growth of the mature plants were satisfactory evidence that the range was improving.

Sampson continued his observations in 1910 and 1911. In 1912, the deferred grazing system was used on 10 allotments of the Wallowa National Forest, and Sampson made a final tour of the Wallowa Mountains and the Standley allotment to show the results of his work to other Forest Service researchers. The sheep

> ...made fully as good progress as other sheep in allotments not handled under deferred grazing...[and]...in every case the carrying capacity of the range has increased materially, and the best interests of the stock industry seem to call for the adoption of the system generally (Sampson 1914, p. 145-146).

Artificial Revegetation

Sampson's reseeding work was part of a more extensive study begun by the Forest Service and the Bureau of Plant Industry in 1907 throughout the Western United States. The species tested, time of planting, and seedbed treatments were dictated by the design of the overall study. His objective in the Wallowa Mountains was to determine either the factors necessary to insure seeding success or the reason for failure on subalpine sites.

The largest reseeding (20 acres) was near Standley Spring. Originally covered with green fescue, the parkland was almost barren in 1907. Annuals were scattered "in profusion" and Ross (sickle) sedge was the most abundant perennial. Dense cover of relatively unpalatable perennial species occurred only adjacent to springs, seeps, and stream channels (Sampson 1913c). The area was hand-seeded in the fall of 1907 with a mixture of common timothy, redtop, and Kentucky bluegrass. The seed was trampled into the soil by driving a compact band of sheep over the area twice.

The same species, individually and mixed, were seeded on a 5-acre plot at Sturgill where Sampson compared a no-planting treatment (seed broadcast on the surface) with brushing and trampling treatments that covered and pushed the seed into the soil. The reseeded site had been annually used as a bedground. Most of the surface 6-inches of soil had eroded away and, except for a small area of dense green fescue and western needlegrass, was "...bare of vegetation save for a few scattered tufts of...[western]... yarrow..., sedge, and ...[little western]... needlegrass..." (Sampson 1913c, p. 12).

Grazing Management: 1911-1980

Wallowa Mountains

He seeded other species and tried other seed planting methods on smaller plots near Standley Spring in the spring and fall of 1908. All reseedings were fenced in 1908 to exclude sheep grazing. Seedling establishment and growth were observed until 1910.

Sampson's studies verified that fall seeding was superior to spring seeding; covering the seed by brushing, harrowing, or trampling resulted in more plants and better establishment than where no treatment was applied; and timothy was the most adapted species of several which had been established.

It was evident that the subalpine environment influenced seedling establishment, growth, and survival. Timothy was essentially the only species remaining in 1910, but studies of its life cycle showed that it was not well-adapted to the short growing season. Individual plants had 50-percent less growth than those grown 3,000 ft lower, root systems were poorly developed, fewer and dwarfed leaves and culms were evident, and smaller seedstalks produced few viable seeds. Sampson concluded that the timothy stands would neither increase nor long persist, particularly under the prevalent grazing methods, and that the 7,300-ft elevation of the Standley Spring and Sturgill Basin reseedings was the maximum at which reseeding should be attempted in the Wallowa Mountains (Sampson 1913c).

Sheep numbers decreased in the Wallowa Mountains following Sampson's work (table 1) mainly because of the lack of forage, but numbers were still too high for the depleted conditions. Overgrazing of many allotments continued until 1940 (Pickford and Reid 1942). Many sheep were still sold by the head, and wool production was a major commodity in the early years. Sheep numbers were, therefore, important to the welfare of sheepmen and, in turn, to the economy of the area. Thus for many years Forest Service personnel felt a stronger responsibility to supply the summer forage needed by sheepmen and their large flocks than they did to their basic responsibility of land stewardship.

Table 1—Sheep numbers on the Wallowa-Whitman National Forest, 1911-1979[1]

Year	Sheep numbers
1906	252,000
1907	166,000
1908	238,800
1911	121,740
1920	61,447
1930	68,876
1940	48,725
1950	12,940
1960	17,462
1970	10,000 (approx.)
1979	10,400 (approx.)

[1] From grazing records, Wallowa-Whitman National Forest. Sheep numbers are for those portions within the original boundaries of the Wallowa and Imnaha National Forests in 1906.

But the Forest Service and sheepmen did follow Sampson's recommendations and voluntarily began to reduce sheep use on some ranges and install deferred grazing systems on others (Sampson 1914). They tested this new system against the "old way" to see if lambs, grazing cured forage on deferred ranges, lost weight. They didn't; average weights, extremely low by today's standards, were 58 and 56 pounds respectively on September 19.[8]

[8] 1913. Report (letter) by J. Fred McLain, Forest Ranger. Historical grazing file. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Standley Allotment

Sheep numbers on the Standley allotment remained about the same for 15 years (table 2). The numbers increased slightly during World War I because the need for additional meat and wool for the war effort effectively halted reductions in numbers and deferment of additional range units.

Following the war, sheep numbers and sheep use again declined in response to the need to improve range conditions. Certain "camps," the grazing units of the allotment, were deferred annually. Furthermore, as permittees quit the sheep business and returned their grazing permits to the Forest Service, those acres were removed from grazing or were added to adjacent allotments on the basis of need. As a result, the present Standley allotment now embraces 54,493 acres and is grazed by one permittee instead of five.

Sheep numbers again declined in 1935, and this continued until World War II when numbers stabilized. Although sheep numbers have fluctuated widely, they have steadily decreased during the last two decades. There was no use of the allotment in some years. In 1980, the 2,000 sheep grazing the Standley allotment for 3 months represents an 88-percent reduction in sheep use since the turn of the century.

Table 2—Annual livestock use of the Standley allotment, 1890-1980[1]

Period	Number of sheep	Average number of months used	Sheep months
1890-1905	10,000 (+ 1,000 cattle)	3.75	52,500
1906-10	10,000	4.00	40,000
1911-20	10,500	3.64	38,252
1921-30	7,750	3.93	30,478
1931-40	6,630	4.12	27,329
1941-50	3,580	3.41	12,229
1951-60	2,690	3.48	9,367
1961-70	2,730	3.41	9,313
1971-75	2,300	3.08	7,093
1980	2,000	3.00	6,000

[1] Data between 1890 and 1910 from interviews with stockmen; from 1911 to 1975 from the files, Wallowa-Whitman National Forest; and 1980 from Bob Barney, Range Convervationist, Wallowa-Whitman National Forest, personal communication.

Standley Spring and Sturgill Basin

Specific use of the grasslands at Standley Spring and Sturgill Basin is of special interest; the photographic comparisons that follow are of these areas.

The 20-acre reseeding exclosure at Standley Spring was sometimes used to hold sheep, but its primary use after 1911 was as a horse pasture. The Standley Guard Station, built near Standley Spring, was the center of administrative activity in this section of the Wallowa Mountains. It housed the first fire guards who kept several horses available in the pasture during the summer and fall seasons, particularly between 1934 and 1955. In addition, the sheep camp near Standley Spring had a long history as a base camp for camptenders, and their horses and pack strings grazed the grasslands when the sheep bands were in the general area. What the horses didn't take, the sheep did. Records indicate that from 1935 to 1955, when the Standley Lookout was dismantled, there were never less than three horses in the pasture during the summer and many others grazed there periodically. All fences were removed in 1956, but some horses still graze the site each summer. Sheep have grazed there once since 1956.

Recovery: 1955-1976

Sturgill Basin apparently was heavily grazed by sheep for many years after Sampson finished his studies in 1910. A 1912 photo of the reseeded area shows no fence and a patchy cover of grazed vegetation. Sturgill Spring, located near the center of the Basin was also a preferred base camp for herders and camptenders, so use of the Basin by horses and as a sheep bedground most likely resumed and resulted in continued overgrazing. The Basin was closed to sheep grazing in 1941 because of further forage depletion and soil erosion. With the exception of one band of sheep grazing 1 day in 1973, it has remained closed to sheep use.

Both the Standley and Sturgill grasslands have seen, in recent years, an increase in horse use associated with increased recreation use of the Eagle Cap Wilderness, particularly during the fall hunting seasons for upland birds and big game. Standley Spring and Sturgill Spring are popular campsites for elk and deer hunters. For a 2-week period in September, 1975, it was estimated that the grasslands around Standley Spring received the equivalent of 245 days of use by horses from two hunter camps and a Forest Service trail maintenance crew.[9]

Data on use by domestic livestock does not tell the entire grazing history following Sampson's studies. Deer and elk numbers in the Wallowa Mountains have increased greatly over the years.[10] Both deer and elk were extremely scarce in 1900. The deer population increased quickly, and by the mid-thirties there was an estimated 30,000 in Wallowa County. Elk populations were just beginning to expand, but their grazing pressure, particularly on livestock-depleted ranges, was beginning to cause concern. Elk use of forage on a subalpine range in the adjacent Blue Mountains in 1940 was 63 percent of that used by sheep in the same area in 1937 (Pickford and Reid 1943); the area had been closed to sheep grazing in 1938 because of poor soil and vegetation conditions.

Elk numbers have steadily increased since 1940, and deer numbers have fluctuated. There was an estimated 15,000 elk and 40,000 deer in Wallowa County in 1969 (see footnote 10) and 17,800 and 21,600, respectively, in 1979.[11] These game animals graze the Standley and Sturgill grasslands and undoubtedly have had some impact on their recovery.

After examining the Standley Spring and Sturgill Basin areas in 1955, Sampson stated that the information on plant succession and its illustration through a comparison of photographs would ". . . provide a contribution to range management that is of real importance, particularly since the work dwelt from the start with a range revegetation and management problem."[12] Unfortunately, most of his assessment of plant succession and recovery was not recorded, but his return provided the stimulus for relocating more of his original photographs and recording information on plant species.

In describing changes in the following photographic comparisons, we quote Sampson's description of the initial photograph if it provides information about the activity or the condition seen. In addition, some descriptions from figure captions in his manuscripts and publications are quoted. Lastly, the conditions in the general area of the photograph are summarized from Sampson's writings or, if easily seen, from the photograph. Data accompanying the repeat photographs are either from plots or transects established in the vegetation shown or from adjacent areas of similar recovery. Maps showing the location of the Standley Spring and Sturgill Basin areas in the Wallowa Mountains, and the camera points for the following photographs are presented in the appendix.

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[9] Roy Sines, Ranger, Wallowa-Whitman National Forest (retired). Personal communication, 1975.

[10] Ron Bartels, Oregon State Wildlife Commission. Personal communication, 1970.

[11] Vic Coggins, Oregon State Wildlife Commission. Personal communication, 1979.

[12] Letter to J. Herbert Stone, Regional Forester, Pacific Northwest Region, Forest Service, from A.W. Sampson, March 5, 1955.

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Figure 2. *View north from CP-17, Sturgill Basin.*

Figure 2A. September 1909. *"Wallowa National Forest. Dense stand of green fescue."*

This stand of green fescue probably was the only such community Sampson found on the Standley allotment that approached climax condition. Another 1909 photograph of this site shows the collecting of seed with a comb seed-stripper that would require a vigorous and relatively pure stand of the fescue. The community is in a drainage adjacent to and west of Sturgill Basin. He gathered seed here for studies on germination, establishment, and growth of green fescue seedlings. Except for some spots of barren soil, the middle and background slopes appear to be well-covered with grass.

Figure 2B. August, 1966. *This area, not in the Sturgill Basin area closed to grazing in 1941, had evidence of recent sheep grazing when the photograph was taken. Green fescue was still the dominant species, but other perennials, particularly western needlegrass, were present in the plant community. The sod was slightly terraced or "stepped" and occasionally dissected from active erosion, leaving pedestals or larger hummocks of green fescue sod. Similar stepped sod, but less prominent, shows in the 1909 seed-collecting photo, so apparently no significant erosion had occurred on this site. On the middle and background slopes some portions of the eroded barren soils were more or less revegetated, and, although tree clumps had thickened, tree encroachment into the grasslands was not evident.*

Figure 3. *View north-northeast from CP-1, Standley Spring.*

Figure 3A. August, 1907. *"Area denuded through grazing. Summer range denuded of vegetation as a result of competition between sheepmen and cattlemen during the free-for-all grazing period."*

Sampson noted in this general area that Ross sedge, hairstem groundsmoke, Douglas knotweed, and little western needlegrass were the more common species on denuded grasslands and that green fescue existed as widely scattered weakened plants.

In 1955, he recalled that, in 1907, there had been no "feed" left in the lower elevation forested areas beyond the background of this photograph. The ungrazed "timber feed" was luxuriant in 1955, and it was difficult to comprehend that there could ever have been "none."[13]

Figure 3B. August 12, 1955. *Western needlegrass and a sedge (abruptbeak sedge ?) dominated the vegetation. Other species included timber danthonia, bentgrass, spike trisetum, Parry rush (near the timber), Idaho fescue (rocky shallow sites), pokeweed fleeceflower, peregrine fleabane, western yarrow, and littleflower penstemon. Sampson and David Costello, a plant ecologist who accompanied Sampson on the 1955 revisit, concluded the vegetation on the eroded soil would not improve significantly in the future.*[14]

Green fescue, which was sparsely present in the center of the grassland, occurred in good stands on topsoil pedestals around the

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[13] Robert W. Harris. Pacific Northwest Forest and Range Experiment Station (retired). Personal communication.

[14] David F. Costello. Pacific Northwest Forest and Range Experiment Station (retired). Personal communication.

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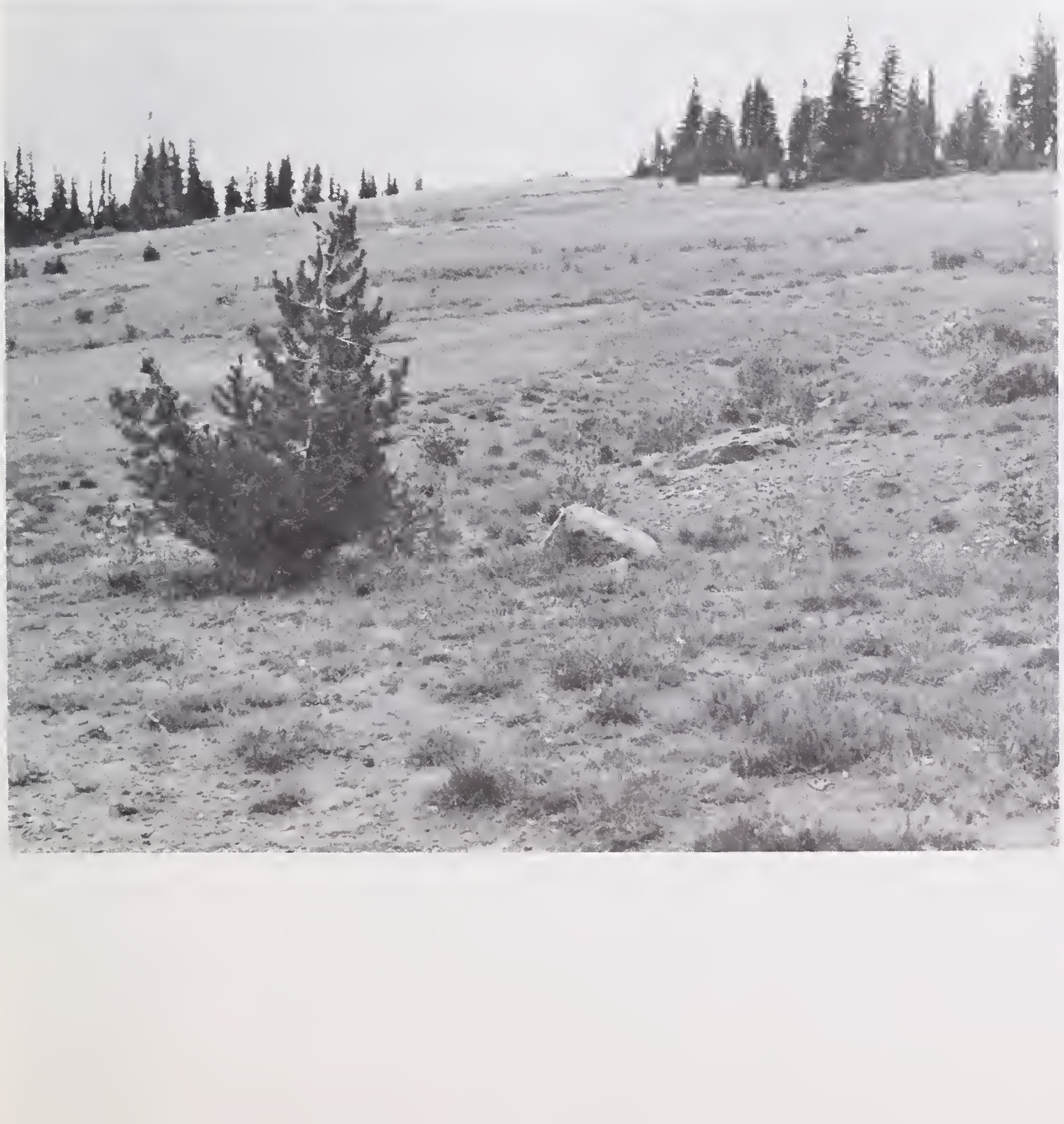

grassland-forest boundary. The presence of the pedestals and the similar surface configuration in both photographs indicated that the topsoil had already been lost from the grassland when the 1907 photograph was taken. Sampson does not specifically mention the existence of soil pedestals, a common, present-day erosion feature of subalpine grasslands, in his publications of the Wallowa Mountain studies or in his photograph captions. We assume, however, from various descriptions, such as "...the original vegetation and network of roots had been seriously injured...by trampling..." (Sampson 1914, p. 113), and "...where many of the tufts had died out, the tussocks were often torn asunder by the sheep passing over them a couple of times" (Sampson 1913c, p. 20), that soil pedestals were present in 1907, but not as prominent as today (see figs. 11-12 and 14-16).

Figure 3C. August 19, 1973. *The needlegrass and various sedges were still dominant in the grassland with the same associated grasses and forbs present. Little western needlegrass and abruptbeak sedge were more abundant in the foreground and drainage area and the forbs less so than observed in 1955, but vegetation cover was less. Western coneflower, apparently not present in 1955, was established in the drainage. Current and future horse use associated with yearly recreational, administrative, and stockmen activities at the nearby Standley Spring campsite and Standley Guard Station will tend to maintain the present plant composition and cover.*

Figure 4. *View east-southeast from CP-2, Standley Spring.*

Figure 4A. June 2, 1908. *"View of the Standley Range with receding snow cover."*

This is the only photograph that shows a major portion (the north half) of the 20-acre exclosure fall-seeded in 1907 to common timothy, Kentucky bluegrass, and redtop. The fence (not yet in place) was across the area in the center of the photograph, up the left margin, and across the skyline. In 1907, the grassland sites seen here were "almost barren" with numerous but inconspicuous annuals and Ross sedge the most abundant perennial. Good vegetative cover occurred only near a few small springs and seeps. In these moist sites, bentgrass, slender hairgrass, alpine timothy, and several sedges and rushes formed dense stands.

The unseeded instrument enclosure, where Sampson followed native species recovery, is outlined by the fence (partially retouched) in and near the receding snow in the upper left (see appendix, fig. 20).

Figure 4B. August 9, 1973. *Parry rush was the dominant plant from the foreground to the circular spots of barren soil. These spots have been maintained in that condition by horses that use them as "rolling beds" and by wind erosion of the fine material. Beyond the spots and the old fence boundary, needlegrass and sedges dominated but yielded dominance to green fescue from the center tree clump to the ridge. No plants of the seeded grasses were found on plots established in the area of the original reseeded exclosure, all or portions of which was used as a holding pasture for sheep and horses until the fence was removed in 1956.*

Vegetative composition and cover varied considerably across the area shown. Average cover of all species was 47 percent, with green fescue accounting for 30 percent. Other important species, in order of cover contribution, were asters, needlegrass, sedges, penstemons, Parry rush, umber pussytoes, and Cusick speedwell.

The most notable change was the establishment, enlargement, and thickening of tree clumps since 1908, a phenomenon more or less evident in many of the repeat photographs.

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Sampson estimated that tree clumps occupied 5 percent of the exclosure area in 1907 (Sampson 1913c). Estimates from aerial photographs showed their coverage to be 9 percent in 1959. Counts and aging of stems on grassland plots show subalpine fir, whitebark pine, Engelmann spruce, and lodgepole pine, in order of abundance, had continually spread and become established in the herbaceous communities. Such was particularly evident around the periphery of the enlarged tree clumps and, on this site, primarily after Sampson's 1955 visit. Prior to the closing of the Standley Lookout in 1955, it was common practice for the fire guard to pull young trees to minimize the rate of tree invasion. Tree clumps therefore would have been larger than presently observed had this not been done.

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Figure 5. *View southeast from CP-6, Standley Spring.*

Figure 5A. June 29, 1908. *"Same area as #77247...[fig. 4, June 2, 1908]...showing snow conditions 8 days later. The conspicuous plant in foreground is spring beauty...[lanceleaf springbeauty]...* Claytonia lanceolata, *which closely follows the recession of snow and announces the early approach of spring."*[15]

Seedlings of the introduced grasses, seeded the previous fall (1907), are not evident in the photograph. Later that summer, however, Sampson recorded an average of 23.4 grass seedlings per square meter (Sampson 1913c). Although this was the lowest count of all his subalpine reseedings, a good cover of grass developed (see fig. 8). The corner of the unseeded instrument enclosure and the clump of subalpine fir, seen here, also appear just left of center near the top of the 1908 photograph in figure 4.

Figure 5B. August 9, 1973. *The dominant plants were green fescue, needlegrass, and sedges. The large plant in the center is pokeweed fleeceflower. No plants of timothy, Kentucky bluegrass, or redtop were found. Subalpine fir had encroached and were still actively encroaching on the late-lying snowbank site. The man is standing on the boulder indicated by the arrow in the 1908 photograph.*

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[15] Either the dates for the 1908 photographs or the "8" days difference Sampson recorded is in error.

Figure 6. *View southwest from CP-4, Standley Spring.*

Figure 6A. October, 1910. *"A hand seeder in use on an overgrazed range area."*

With the exception of some widely dispersed plants on the slopes in the background, this site was without vegetative cover. This photograph and those in figures 7 and 8, were taken to illustrate Sampson's methods of spreading and covering grass seed in his experimental plots. The barren sites illustrated not only straddled a main access trail but also were adjacent to the permanent sheep camp at Standley Spring. The constant trailing and, most likely, long use of the area as a bedground had eliminated the vegetation. There is no record of this area having been seeded.

Figure 6B. August 9, 1973. *Perennial forbs dominated the 15-percent vegetative cover. In order of abundance, littleflower penstemon, leafybract aster, umbellate pussypaws, umber pussytoes, and western yarrow accounted for 70 percent of the cover; needlegrass, sedges, and Parry rush 28 percent; and green fescue 2 percent. An almost pure community of Parry rush occurred on the background slopes. Parry rush is not readily grazed by sheep, so possibly the plant was present in 1910. In Sampson's ordered listing of the 44 plants supplying 90 percent of the sheep forage, Parry rush was rated 42 (Sampson 1914).*

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Figure 7. *View north from CP-5, Standley Spring.*

Figure 7A. September 15, 1909. *"A brush harrow in use." It was constructed "...with the materials available...[in]...about one hour's time."*

A few unknown perennial plants were present on this barren site which is part of that described for figure 6. The good grass cover to the right of the fence is the ungrazed, 2d-year growth of timothy, Kentucky bluegrass, and redtop seeded in the fall of 1907. Sampson stated that timothy had become dominant and redtop, although present, was not adapted to the site.

Figure 7B. August 9, 1973. *Vegetative cover and composition was dominated by needlegrasses and sedges. Leafybract aster, littleflower penstemon, and spike trisetum were the more common associates. Scattered seedlings and many small plants of little western needlegrass, spike trisetum, and umbellate pussypaws were noted on the spots of bare soil. It was also noted that horses, however, in using these "rolling beds," tended to eliminate any plants and pulverize the soil. Wind erosion of soil out of these spots was observed.*

Figure 8. *View northeast from CP-3, Standley Spring.*

Figure 8A. September 15, 1909. *"A wooden A-harrow recommended for use on well-packed soils where the brush harrow is not effective." It was ". . . used effectively in an artificial reseeding near timberline, Wallowa National Forest, Oregon."*

The site appears to have been completely denuded of vegetation.

Figure 8B. August 9, 1973. *Vegetative cover was sparse with much barren soil still present. Forbs, such as western yarrow, littleflower penstemon, leafybract aster, pussytoes, and cinquefoil were prominent. Needlegrasses, sedges, and Parry rush accounted for only 20 percent of the total plant cover. Vigorous green fescue plants occurred in the background around young subalpine fir and whitebark pine. These trees are established in former grassland. The large plant in the foreground is pokeweed fleeceflower, a long-lived forb commonly found on depleted subalpine grasslands. Because of its proximity to Standley Spring and the main access trail, this site was still receiving heavy grazing and trampling by pack and recreational horses.*

Figure 9. *View east from CP-13, Sturgill Basin.*

Figure 9A. September 24, 1908. *"View of the seeded area. . .[in Sturgill Basin]. . . at the end of the first year of growth. The young growth is mainly timothy. On plot V the seed was brushed in while plot IV was 'harrowed' by trampling sheep."*

The best seedling stand (92.8 seedlings/m²) was on the brushed area V; however, this density and that on the trampled plot IV (38.5/m²) is not readily apparent in the photograph (Sampson 1913c).

Sampson selected and reseeded this 5-acre bedground in the fall of 1907 to replicate the 20-acre reseeding at

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Standley. He stated that "... the ground is smooth except for occasional narrow ruts caused by erosion in the spring. The area formerly bore a heavy growth of green fescue but is now bare of vegetation save for a few scattered tufts of yarrow, ... sedge, and needlegrass" (Sampson 1913c, p.12). Judging from this photograph and that in figure 10, this was surely true for most of the area, but he noted on his map (Sampson 1913c, p. 12) that a thin stand of green fescue and needlegrass occurred in his plot I, an area not seen in this photograph.

Figure 9B. August 13, 1955. *In the immediate foreground, an almost pure stand of western needlegrass (90 percent of the species composition) accounted for most of the 22-percent vegetative cover. Other species listed were sedges, umber pussytoes, umbellate pussypaws, Parry rush, orange agoseris, Douglas knotweed, and spike trisetum. Step-point transect data showed that 48 percent of the still-smooth ground surface was covered by dense grass litter. A small erosion channel runs parallel to and near the position of the old fence and was likely a result of both sheep trailing along the fence during the study years and from water erosion thereafter.*

Figure 9C. August 8, 1973. *Species composition and coverage in the foreground was similar to that measured in 1955; however, data from plots distributed within the grass community (to the far tree clumps) showed that needlegrass, sedge, and green fescue equally accounted for two-thirds of a 39-percent vegetative cover. Of the remaining 18 species listed, cover of both Parry rush and umber pussytoes was 3 percent.*

As at Standley, subalpine fir and whitebark pine had densely reestablished in the old tree clump area circumscribed by the snags in the 1907 photograph. Their seedlings also had become established, many since 1955, in the sparse grassland in the middle distance. But tree invasion of the 1907 seeded exclosure area was almost nil at this date.

Figure 10. *View west from CP-14, Sturgill Basin.*

Figure 10A. July, 1909. *"Another view of plots IV and V...[in the Sturgill exclosure]...showing the forage growth at the end of the second year. The brushed (V) and trampled (IV) areas have a ground cover of approximately 60 and 40 percent, respectively. Species predominating at this time is timothy."*

Other than the seeded species, western yarrow is recognizable and relatively abundant. The dark and light areas beyond the fence are deeply eroded soils, barren of vegetation.

In the publication of his results (Sampson 1913c), an error was made, either in the map of the exclosure (his fig. 3), the seedling data (his table 3), or in the labeling of this photograph and that in figure 9. From the positions established for rephotography, the labeling on this photograph has been corrected to correspond with his original map, but the error in his table 3 still exists.

Figure 10B. August 8, 1973. *Transect data and photos in 1955, 1962, and 1966 showed that plant cover was similar to that observed at this date. Where vegetation existed, the estimated cover (59 percent) was primarily needlegrass (16 percent), green fescue (16), sedges (12), and umber pussytoes (10). All trees established in the grassland were whitebark pine.*

In 1955, one of us (Hall) noted that vegetation in Sturgill Basin was still recovering from the poor condition observed prior to its closure to grazing in 1941. Needleleaf sandwort mats still persisted as relics, sedges and western needlegrass were invading barren soils and gullies, and vigorous green fescue plants were becoming established in the needlegrass and sedge dominated communities on the old "brushed" plot. In 1973, the large barren soil areas within and beyond the former fence boundary remained relatively devoid of plants (see fig. 11) indicating that the invasion noted in 1955 did not continue on these areas. Attempts between 1940 and 1963 to revegetate these sites by reseeding introduced species with various mulching and fertilizer treatments were unsuccessful. A transplanting trial by one of us (Hall) in 1964, using

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mature green fescue plants, was completely successful; the plants were still present in 1977. This substantiates Sampson's observations that soil drought and spring and fall frost heaving on barren soils can eliminate a seedling crop, but not damage older plants.

Figure 11. *View north from CP-15, Sturgill Basin.*

Figure 11A. August 13, 1955. *Photographed during Sampson's 1955 trip, this site lies outside of but adjacent to Sampson's plot I in the Sturgill exclosure. It was on part of this plot that he obtained a poor stand of timothy because the "superabundance" of native plants "...prevented much of the seed from coming in contact with the soil" (Sampson 1913c, p.12). No notes were taken in 1955 on which species dominated the dense grass community.*

Figure 11B. August 8, 1973. *Vigorous green fescue on large soil pedestals, up to 12 inches in height, dominated the grassland community as it most likely did in 1955. Umber pussytoes, sedge species, and western needlegrass also occurred in all plots but totally accounted for only a small percentage of the 56-percent cover. A few small plants of one species, umbellate pussypaws, were established on the barren soils.*

The soil pedestals, supporting vigorous green fescue in 1955, were still present whereas those with less vigorous plants or devoid of vegetation in 1955 (outlined on photo B) are not. This comparison shows the stability of the soil pedestals when bound by dense live roots of fescue and their instability without this live root mass. Although bound tightly by dead roots, the pedestals eventually erode from water, wind, and frost action, a process that is speeded up when the pedestals are subject to trampling (Sampson 1913c). If quickly revegetated by grasses, sedges, or some forbs, however, the pedestals have been known to maintain their structure for more than 40 years, even under moderate sheep use (Reid et al. 1980). Tree invasion and establishment does not insure continued sod stability; an erosion pavement was characteristic under the few trees established in the pedestaled grasslands in Sturgill Basin. In this photograph, the whitebark pine, present as a seedling in 1955 (arrow), had become established on eroded soil between remnant pedestals.

Figure 12. *View north from CP-9, Standley Spring.*

Figure 12A. July 12, 1907. *"View of Station No. 4. . .[instrument enclosure]. . .looking north. A small badly depleted area. . .[to be]. . .protected by the Forest Service against grazing for five years. . . to determine the time . . .[required]. . .for revegetation which is usually slow on badly trampled lands. . . . "*

The photograph shows the general vegetative cover in the instrument enclosure at Standley the year it was fenced. The records from a permanent quadrat (see fig. 15), seen near the left margin in this photo, provide the only quantitative data available and indicates that most of the plants seen are green fescue, fernleaf licoriceroot, and Cusick speedwell.

Figure 12B. July 15, 1909. *"The increase in forage is due to vegetative growth and not to reproduction from seed."*

Sampson provided no quantitative description of the plant species or cover seen in this photograph nor in the following 1911 photograph. After 3 years of protection from grazing, however, he noted vigor of all plants had improved and some had increased in size, but few perennial grass seedlings had become established on the barren soil areas. Green fescue, needlegrass (coarse bunches), fernleaf licoriceroot, and Cusick speedwell appear in the photograph.

Note the absence of most alpine fir snags present in the 1907 photo. They were felled to supply fence post material for the Standley exclosure which was completed in the spring of 1908.

Figure 12C. 1911. *After 5 years of protection, Sampson wrote that vigorous green fescue was now producing an abundance of viable seed, and new fescue plants were established in the open spaces between older plants.*

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Figure 12D. August 12, 1955. *Vegetative cover was 32 percent, of which three-fourths was green fescue. Fescue plants were almost wholly confined to elevated pedestals or larger hummocks of soil. Most of the remaining cover, in order of abundance, was needlegrass, leafybract aster, and Cusick speedwell. Transect measurements in 1964, following a 4-year drought, showed that cover had decreased to 25 percent. Most of the decrease had been in green fescue. Needlegrass and sedge cover had not changed.*

Figure 12E. July 29, 1976. *Vegetative cover (measured in 1973) was similar to that measured in 1955. Green fescue again comprised three-fourths of the cover. Leafybract aster, needlegrass, and abruptbeak sedge accounted for most of the remainder. Several seedlings of whitebark pine and subalpine fir are established in the area shown. The 12-ft whitebark pine was about 3 ft in 1955.*

Figure 13. *Arthur W. Sampson holding copper tag found at Standley Spring in 1955. The tag is inscribed "Plot I Sept. 16, 1907 Denuded."*

Table 3—Percent of cover on charted quadrat on Standley allotment 1955, 1964, and 1972

Species	Percent plant cover 1955	1964	1972
green fescue	27.6	18.4	27.2
abruptbeak sedge	1.3	4.7	6.5
leafybract aster	7.9	1.2	1.9
Cusick speedwell	1.1	.9	.9
haircap moss	*	.7	1.4
peregrine fleabane	1.1	*	*
slender hairgrass			*
umbellate pussypaws	*	*	*
whitebark pine (seedling)			*
Total	39.0	25.9	37.9

* = Less than 0.5 percent.

The cycling of green fescue cover observed in this photograph series between 1955 and 1976 was also observed on a chart quadrat established in 1955 near CP-10 (for location, see appendix, fig. 20). It was at this camera point that Sampson, in 1955, found the copper tag, still wired to a small fragment of wood, that he used to mark his denuded quadrat #1 in 1907 (fig. 13). Plant cover (table 3) was charted in 1955 and recharted in 1964 and 1972 (fig. 14).

In 1955, green fescue occupied a major portion of an elevated soil hummock oriented vertically through the center of the quadrat. Leafybract aster occurred in dense small mats on the periphery of the fescue sod. Abruptbeak sedge, third in importance, occurred in two clumps, one on the hummock and the other on the eroded soil. Cusick speedwell and peregrine fleabane were most prominent on the eroded soil.

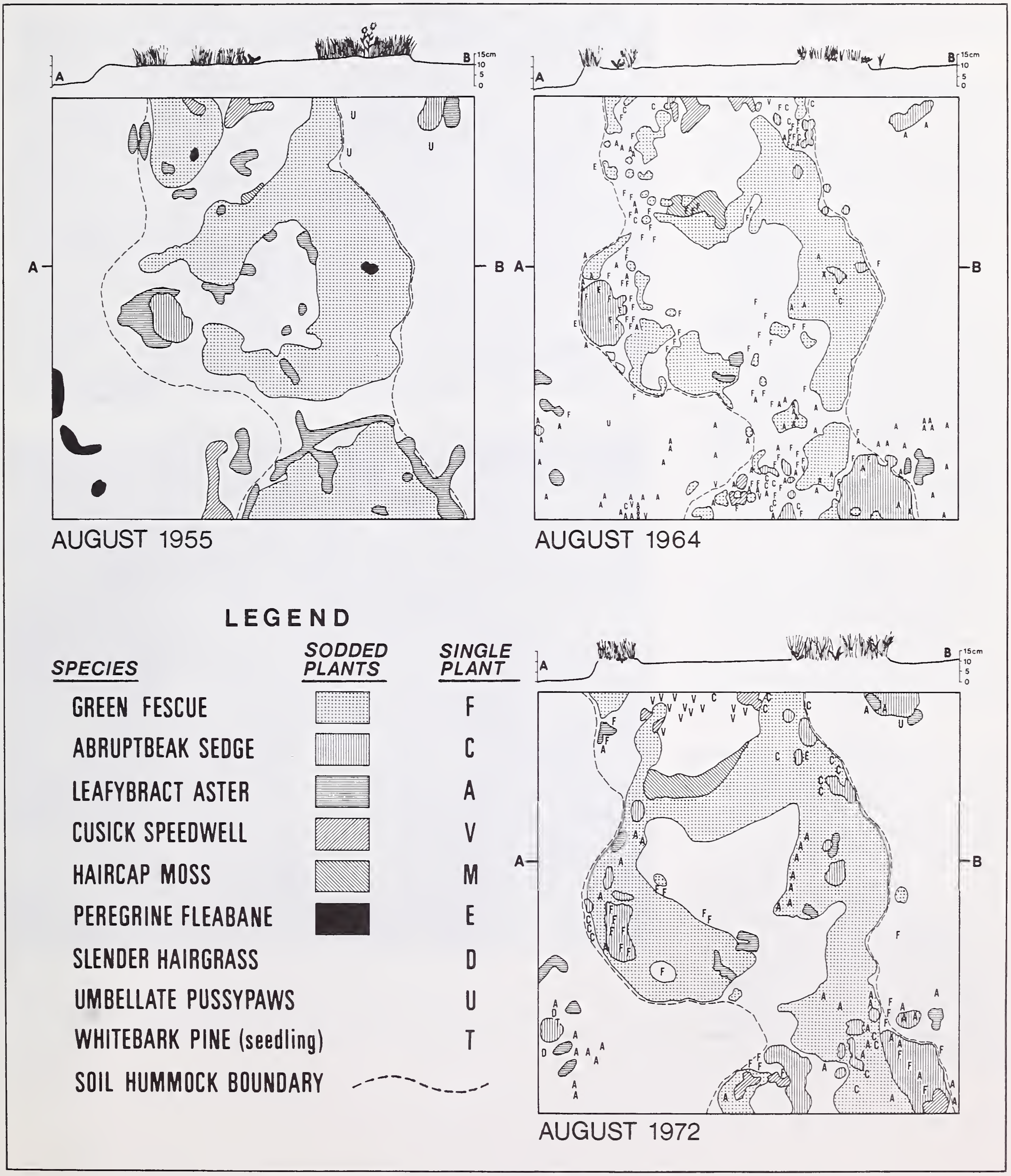
From 1960 through 1963, particularly in 1963, precipitation during the growing season in northeastern Oregon was below average and temperatures were generally above average. Beginning in 1964, with the exception of a very dry season in 1967, precipitation and temperature were generally normal; but precipitation was much above average in 1970, 1971, and 1972.[16]

Following the dry period, green fescue cover had decreased and retreated to the periphery of the hummock in 1964. Its tiller density was sparse and vigor was poor. The sodded area in the center of the hummock appeared as dead plant crowns, tillers, and litter. Abruptbeak sedge and haircap moss cover had increased, the sedge from establishment and growth of new plants on the soil hummock and the haircap moss from enlargement of the original mat. Aster, speedwell, and fleabane had decreased in cover, mostly from a decrease in size or a breaking-down of former clumps and mats to many individual plants. Most of these small individual plants were established near the periphery of the elevated hummock or on the eroded soil around its base; few plants, of any species, occurred in the center of the hummock or on the eroded interspaces between hummocks (hummocks in the general area were spaced 1-3 ft apart). To a lesser extent, new sedge plants also tended to have a greater affinity for establishment in the hummock edges.

Dense vigorous green fescue tillers again occupied much of the hummock area in 1972, and its cover about equaled that charted in 1955. The sedge plants had thickened into definitive clumps, and the mat of haircap moss had doubled in size. Large leafy plants of speedwell and aster resulted in similar or slightly increased cover, although their plant numbers had decreased. As in 1964, these forb and sedge plants occurred primarily near the edge of the elevated hummock and/or the edge of the live fescue sod. This site association has been noted in other similarly eroded, subalpine communities (Ellison 1949, Maser and Strickler 1978). Ellison's experiments and observations showed that plant establishment, resulting in such associations, occurred because soil moisture and stability was better and temperature extremes and frost heaving less common on and around the base of the sodded hummocks than on the eroded interspaces. His work supports Sampson's earlier observations on the inability of most native plants to become established on the eroded soil and that continued grazing was not solely responsible in preventing establishment.

Figure 14. *Charts of permanent quadrat on Standley allotment, 1955, 1964, and 1972.*

[16] Annual summaries, climatological data, Oregon. From National Oceanic and Atmospheric Administration, Environmental Data Service, National Climatic Center, Asheville, North Carolina.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AUGUST 1955
AUGUST 1964
AUGUST 1972
LEGEND
SPECIES
SODDED PLANTS
SINGLE PLANT
GREEN FESCUE F
ABRUPTBEAK SEDGE C
LEAFYBRACT ASTER A
CUSICK SPEEDWELL V
HAIRCAP MOSS M
PEREGRINE FLEABANE E
SLENDER HAIRGRASS D
UMBELLATE PUSSYPAWS U
WHITEBARK PINE (seedling) T
SOIL HUMMOCK BOUNDARY

Figure 15. *View northeast from CP-7, Standley Spring.*

Figure 15A. August 16, 1907. *"Detailed photo of quadrat at Station 4."*

Sampson did not record the number of the quadrat shown, but the distribution of vegetation on the quadrat somewhat matches that which he charted 43 days earlier on his permanent quadrat #1 (Sampson 1914, p.122). Total vegetative cover was 15 percent, of which fernleaf licoriceroot and green fescue accounted for 8 and 5 percent, respectively. The remaining cover consisted of Cusick speedwell, littleflower penstemon, and abundant but inconspicuous Douglas knotweed plants. Recharted in 1909, Sampson noted that slight increases in plant size of licoriceroot and green fescue had increased the cover to 18 percent and that five seedlings of green fescue had survived the summer drought (Sampson 1914).

Figure 15B. July 29, 1976. *Green fescue dominated the plot area and occurred on soil pedestals elevated 3-6 in above the surrounding surface. Western needlegrass and Cusick speedwell also occurred on the plot. Leafybract aster and sedges were absent on the plot area but common in adjacent vegetation.*

Soil pedestals, a common phenomena in eroded subalpine grasslands, were prominent along both sides of the swale oriented diagonally across the photograph and just beyond the plot. The 1907 photograph shows a relatively uniform soil surface with only slight erosion in the swale area. Thus, in 1976, assuming that the tops of the pedestals were at the level of the old surface, considerable soil erosion continued after Sampson's studies, but when this occurred and at what rate, is unknown. Slight soil erosion was still occurring in the poorly vegetated swale and between the elevated pedestals.

A

B

A

B

Figure 16. *View north-northeast from CP-8, Standley Spring.*

Figure 16A. July 1909. *Sampson recorded summer precipitation, evaporation, air temperature, humidity, and soil moisture at this installation. After 2 years of protection, the majority of plants around the installation are fernleaf licoriceroot, a prominent species in the enclosure in 1907.*

Figure 16B. July 29, 1976. *The estimated 50-percent vegetative cover consisted of green fescue (25 percent), leafybract aster (15), needlegrasses, sedges, and Cusick speedwell (8). The licoriceroot was found neither here nor at any other site within the fescue community but was noted elsewhere on relatively barren, shallow stony soils. As noted in figure 15 and shown here, most green fescue growth was confined to soil pedestals and hummocks, indicating further erosion of the land surface had occurred after 1909.*

Figure 17. *View northwest from CP-11, Standley Spring.*

Figure 17A. August 16, 1907. *"The overgrazing by sheep. A depleted sheep range in the Wallowa Mountains...[at 7,400]...feet elevation in the Hudzonian zone, showing the upper limits at which seeding will pay. Note the characteristic scattered, but luxuriant growth of whitebark pine and subalpine fir. At slightly higher points where these trees become dwarfed, reseeding will not pay."*

The few plants seen (species not recorded) appear to be forbs. Plant cover appears to be denser toward the larger group of sheep in the middle distance, beyond which was the "almost barren" soils of the Standley exclosure, seeded about 1 month after the photo was taken.

Figure 17B. August 9, 1973. *Thirty-one herbaceous species accounted for the vegetative cover (60 percent) in the foreground plant community. Woolly and umber pussytoes, Parry rush, green fescue, and sedges equally accounted for 44-percent cover, and the needlegrasses, Cusick speedwell, and timber danthonia, 12 percent. Parry rush and umber pussytoes (the low white plant) were the dominant species in the foreground and the green fescue in the grassland beyond the trees.*

The taller subalpine fir trees are those seen in the 1907 photograph. The whitebark pine (center) is 53 years old. Considerable expansion of subalpine fir and whitebark pine seedlings into grassland communities had occurred in this area since 1955, particularly north and northwest of the tree clumps where snow lies late and shade delays summer soil drought.

A

B

A

B

Figure 18. *View southeast from CP-12, Standley Spring.*

Figure 18A. July 25, 1908. *"View of Bear Creek drainage from ridge east of old. . .[Standley]. . .Guard Station showing the dominantly irregular topography of the upper grazing lands."*

The stony steep slopes in the right foreground are almost devoid of plants; some pokeweed fleeceflower is evident in the photograph. The grassland slope in the left middleground is badly trailed. On the middle distant ridge are a large number of fallen snags. Sampson noted that, about 20 years previous, practically all of the timber in a large portion of Bear Creek had been killed by a fire and had left the ground strewn with logs (Sampson 1913c).

Figure 18B. July 28, 1976. *Whitebark pine and subalpine fir density had greatly increased on the middle distant ridge, although many were probably present as seedlings and saplings in 1907. Only small remnants, particularly root pieces, of the fallen snags were present. Mountain hemlock (center foreground), Engelmann spruce, and subalpine fir groupings had enlarged, and many young trees were becoming established on the still actively eroding soil around the enlarged tree groups. Herbaceous vegetation cover was still sparse and California falsehellebore, pokeweed fleeceflower, nettleleaf gianthyssop, and penstemons were the more conspicuous of the several forbs present. Green fecsue occurred on the hummocks in the left middleground.*

Notable is the similar size of snowbanks in both photographs. The 1975-76 winter produced above average snowpacks in the Wallowa Mountains, and good moisture conditions prevailed through the 1976 growing season (Soil Conservation Service 1976). Sampson (1909, p. 21) indicated that similar snowpacks had occurred in 1908; ". . .little of the ground on the main high range was free of snow until July 1, and even then portions of the largest snow drifts remained."

Discussion

Sampson's work, between 1907 and 1911 in the Wallowa Mountains, was significant in subsequent management of National Forest ranges. The management recommendations he developed on the depleted Wallowa ranges were put into practice, albeit slowly not only in the Wallowa Mountains but also elsewhere, and were generally adopted into range management thinking in the Western United States. Today, deferred grazing, in some form, is used on many National Forest allotments either to improve poor range conditions or to maintain good conditions through improved livestock distribution.

Sampson's reseeding guidelines, based on the Wallowa work, are often reiterated in reseeding research and rehabilitation of disturbed sites (for example, see Brown et al. 1976). His published recommendations, such as for preparing a seedbed, seeding species adaptable to the site and environmental conditions, seeding in late fall prior to snowfall, covering the seed, and protecting the seedlings from grazing through the first growing season, are still valid for high elevation lands.

The 1955-1976 photographs, of the same areas photographed by Sampson between 1907 and 1911, illustrate the "remarkable recovery" which Sampson often spoke of during his 1955 visit. The early vegetation depletion and soil erosion, however, had essentially modified the grassland habitats, regulating the rate and amount of recovery of species and plant communities, so that no areas recovered to green fescue climax. The present vegetation is a variety of species in a number of plant communities in secondary successional stages.

Where uneroded topsoil remained or occurred in sufficient amounts in remnant pedestals, green fescue has either regained or shares dominance, particularly with needlegrasses and sedges, and vegetative cover ranges between 40 and 60 percent.

On eroded sites, which often had no vegetation in 1907, recovery has been variable. Those seeded by Sampson now have a native plant cover that is 20-50 percent less than that which recovered naturally from remnant fescue. The reseeded grasses are not present today, but we believe the reseeding survived for a sufficient time to provide an environment suitable for speedier reestablishment of native species, a phenomenon recently noted by Brown et al. (1976) in Montana. Green fescue is the major component of communities where it was present when reseeded and subsequent erosion was not severe. Needlegrasses, sedges, and forbs often dominate reseeded areas where topsoil was lost and fescue was absent in 1907, but green fescue has reestablished in these areas, and in some, is codominant with these species.

Some barren sites, not seeded in 1907, essentially remain in that condition. Some are near trails and campsites, and indications are that continued grazing, particularly by horses, is a major deterrent to recovery. On other sites, seeding and transplant trials indicate that spring frost heave and summer drought are still effectively preventing seedling establishment even though the sites have had long protection from livestock use.

Some sites, barren in 1907, exhibited a fair to good vegetation cover after 1955. Needlegrasses, Parry rush, sedges, and numerous forbs, several of which are long-lived, dominate on these sites. The cover is generally between 20 and 40 percent, and green fescue has only recently begun to increase its cover in the plant community.

It appeared that maximum vegetative cover and plant density potential of many eroded sites had been reached before 1955. Further improvement between 1955 and 1976 was minimal, but in the future, green fescue can be expected to slowly reestablish itself on most sites (Reid et al. 1980). Where these grasslands occur along access trails adjacent to and within the Eagle Cap Wilderness, recovery may be slowed because of the selective heavy grazing of green fescue by horses. Observed heavy use of green fescue by elk in other subalpine areas show they too could slow recovery. If needs for forage and protective plant cover in subalpine areas increase over that now supplied by the recovering plant communities, more intensive management or manipulation of the land, vegetation, human use, and grazing animals will be necessary.

If the need is great in limited areas, it may be necessary to proceed with the agricultural approach and develop man-directed communities as Sampson did. If so, adaptable native or commercially available species must be seeded and perhaps enhanced by fertilization, weeding, or other agronomic techniques. Where frost heaving is intense, transplanting may be necessary. Costs will be high and subsequent management must be intensive. Ecological trends, such as the recent widespread encroachment of trees into grassland communities, may have to be controlled.

If needs are simple and static, the naturally occurring plant succession may be sufficient. This is the least expensive management approach, but a longer time is involved and the result may not be desirable. Between these two viewpoints, there is a wide area to apply our present knowledge of ecological principles to manage subalpine grasslands.

Conclusions

With management, the "practically valueless" subalpine ranges in the Wallowa Mountains, depleted by unregulated sheep and cattle grazing from 1880 to the early 1900's, have greatly improved, as documented in this and other studies. Yet, further improvement and successional development seems possible. "Sammy," as Dr. Sampson was known to friends, provided the beginning. It is the responsibility of today's managers to continue the work and the study to "...provide a contribution to range management that is of real importance."

Acknowledgments

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Appendix

Common and Scientific Names of Plant Species in the Study Areas[1]

Trees and Shrubs

Engelmann spruce	*Picea engelmanni* Parry
grouse whortleberry	*Vaccinium scoparium* Leiberg
lodgepole pine	*Pinus contorta* Dougl.
mountain hemlock	*Tsuga mertensiana* (Bong.) Carr.
subalpine fir	*Abies lasiocarpa* (Hook.) Nutt.
whitebark pine	*Pinus albicaulis* Engelm.

Grasses

alpine timothy	*Phleum alpinum* L.
bentgrass	*Agrostis variabilis* Rydb.
bottlebrush squirreltail	*Sitanion hystrix* (Nutt.) Smith
California brome	*Bromus carinatus* Hook. & Arn.
common timothy	*Phleum pratense* L.
green fescue	*Festuca viridula* Vasey
Idaho fescue	*Festuca idahoensis* Elmer
Kentucky bluegrass	*Poa pratensis* L.
little western needlegrass	*Stipa occidentalis* Thurb. *minor* (Vas.) Hitch.
redtop	*Agrostis alba* L.
slender hairgrass	*Deschampsia elongata* (Hook.) Munro
spike trisetum	*Trisetum spicatum* (L.) Richter
timber danthonia	*Danthonia intermedia* Vasey
western needlegrass	*Stipa occidentalis* Thurb.

Sedges and Rushes

abruptbeak sedge	*Carex abrupta* Mackenzie
blister sedge	*Carex vesicaria* L.
dunhead	*Carex phaeocephala* Piper
elk sedge	Carex geyeri Boott
Holm's Rocky Mountain sedge	*Carex scopulorum* Holm
Hood sedge	*Carex hoodii* Boott
Parry rush	*Juncus parryi* Engelm.
Raynolds sedge	*Carex raynoldsii* Dewey
Ross sedge	*Carex rossii* Boott
Sierra-hare sedge	*Carex leporinella* Mackenzie

Forbs

arrowleaf groundsel	*Senecio triangularis* Hook.
California falsehellebore	*Veratrum californicum* Durand
cinquefoil	*Potentilla* spp.
Cusick speedwell	*Veronica cusickii* Gray
Douglas knotweed	*Polygonum douglassii* Greene
fernleaf licoriceroot	*Ligusticum tenuifolium* Wats.
fireweed	*Epilobium angustifolium* L.
haircap moss	*Polytrichum juniperinum* Hedw.
hairstem groundsmoke	*Gayophytum ramosissimum* Nutt.

[1] Species listed are those recorded on plots at Standley Spring and Sturgill Basin, 1973-1976. With only two exceptions, botanical nomenclature follows Hitchcock and Cronquist (1973). *Carex abrupta* and *Polytrichum juniperinum* were identified by F.J. Hermann, Forest Service Herbarium, Fort Collins, Colorado.

Forbs, continued

lanceleaf springbeauty	*Claytonia lanceolata* Pursh
leafybract aster	*Aster foliaceus* Lindl.
littleflower penstemon	*Penstemon procerus* Dougl.
monkeyflower	*Mimulus* spp.
needleleaf sandwort	*Arenaria aculeata* Wats.
nettleleaf gianthyssop	*Agastache urticifolia* (Benth.) Kuntze
orange agoseris	*Agoseris aurantica* Greene
Pacific onion	*Allium validum* Wats.
pearleverlasting	*Anaphalis margaritacea* (L.) B. & H.
peregrine fleabane	*Erigeron peregrinus* (Pursh) Greene
pokeweed fleeceflower	*Polygonum phytolaccaefolium* Meisn.
shootingstar	*Dodecatheon* sp.
sitka valerain	*Valeriana sitchensis* Bong.
skunkleaf polemonium	*Polemonium pulcherrimum* Hook.
skyrocket gilia	*Gilia aggregata* (Pursh) Spreng.
sulfur penstemon	*Penstemon attenuatus* Dougl.
thickstem aster	*Aster integrifolius* Nutts.
umbellate pussypaws	*Spraguea umbellata* Torr.
umber pussytoes	*Antennaria umbrinella* Rydb.
western coneflower	*Rudbeckia occidentalis* Nutt.
western yarrow	*Achillea millefolium* L.
woolly pussytoes	*Antennaria lanata* (Hook.) Greene

Location Maps of Standley Spring and Sturgill Basin

An additional objective of this paper was to bring together, under one cover, Sampson's original photographs of the subalpine grasslands at Standley Spring and Sturgill Basin. Our purpose was two-fold:

1. To provide an easily-obtained repository of the photographs in case the file photographs or negatives are either lost or destroyed. Continuation of future rephotography and comparison would thereby be assured.

2. To provide anyone—hunter, backpacker, ecologist, range scientist—the opportunity to observe and compare present vegetation and range conditions with those in the past. Many people do not realize that range conditions were so much worse in earlier days than they are now, nor do they have many opportunities to observe those conditions. The photographs will provide the historical perspective. To quote Winston Churchill, "Those who fail to study history, are doomed to live it over."

Figures 19, 20, and 21 will help visitors access Standley Spring and Sturgill Basin and relocate the photographed sites.

The best access to both areas, by foot, horseback, or cycle, is by Trail No. 1677 from the end of the Big Canyon Road near Bear Wallowa Spring (fig. 19). The Big Canyon Road leaves State Highway 82 one mile east of Minum, Oregon, and proceeds south 15 miles to road's end. From here, the trail follows a ridge 5 miles, and rises 1,275 ft to the 7,300-ft level at Standley Spring. Trail No. 1680 continues along the same ridge 6 miles to Sturgill Basin at 7,450 ft. Named the "Washboard Trail," there are many but minor elevational changes. Cycles are prohibited from this and the following trails as they enter the Eagle Cap Wilderness.

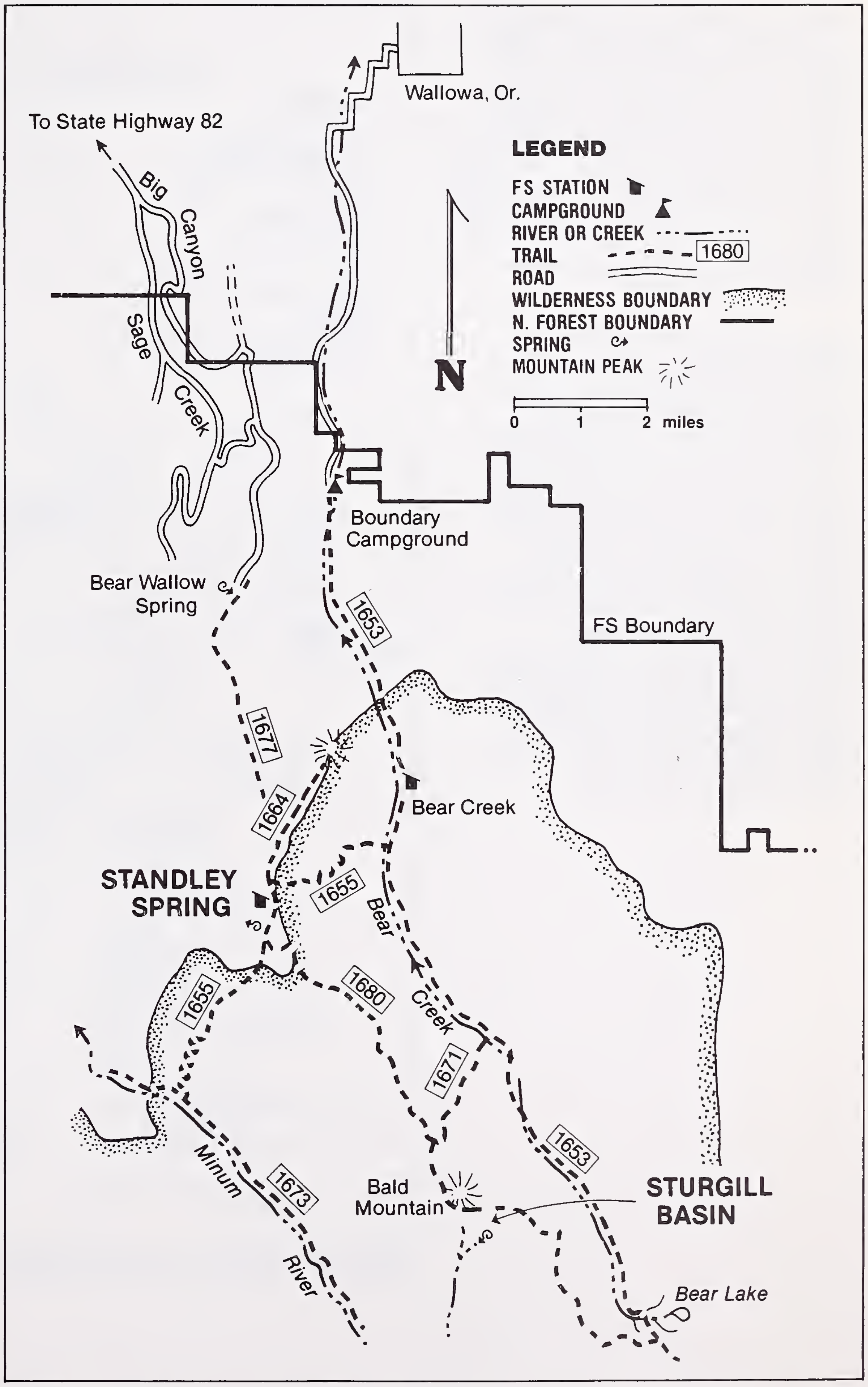

Figure 19. *Location of Standley Spring and Sturgill Basin.*

Both study areas are also accessed via the Bear Creek Trail (No. 1653) beginning at the Boundary Campground, 7.5 miles south of Wallowa, Oregon. Trail distances are greater, however, and the elevational rise is steeper; from Bear Creek to the ridge near both study areas, the elevational rise is 2,700 ft on Trail No. 1655, and 2,150 ft on No. 1671. The distance to Sturgill Basin via Bear Lake is approximately 18.5 miles.

Camera points at Standley Spring and Sturgill Basin, and some physical, topographical, and landscape features that will aid in relocating camera points are shown in figures 20 and 21, respectively. The camera points are marked with metal stakes. The viewing direction is given in the appropriate figure caption. For the more serious student, detailed maps of the study areas are filed at the Range and Wildlife Habitat Laboratory, La Grande, Oregon. Road, trail, and camping information is obtainable from the District Ranger, Wallowa Valley Ranger District, Wallowa-Whitman National Forest, P.O. Box 490, Enterprise, OR 97828.

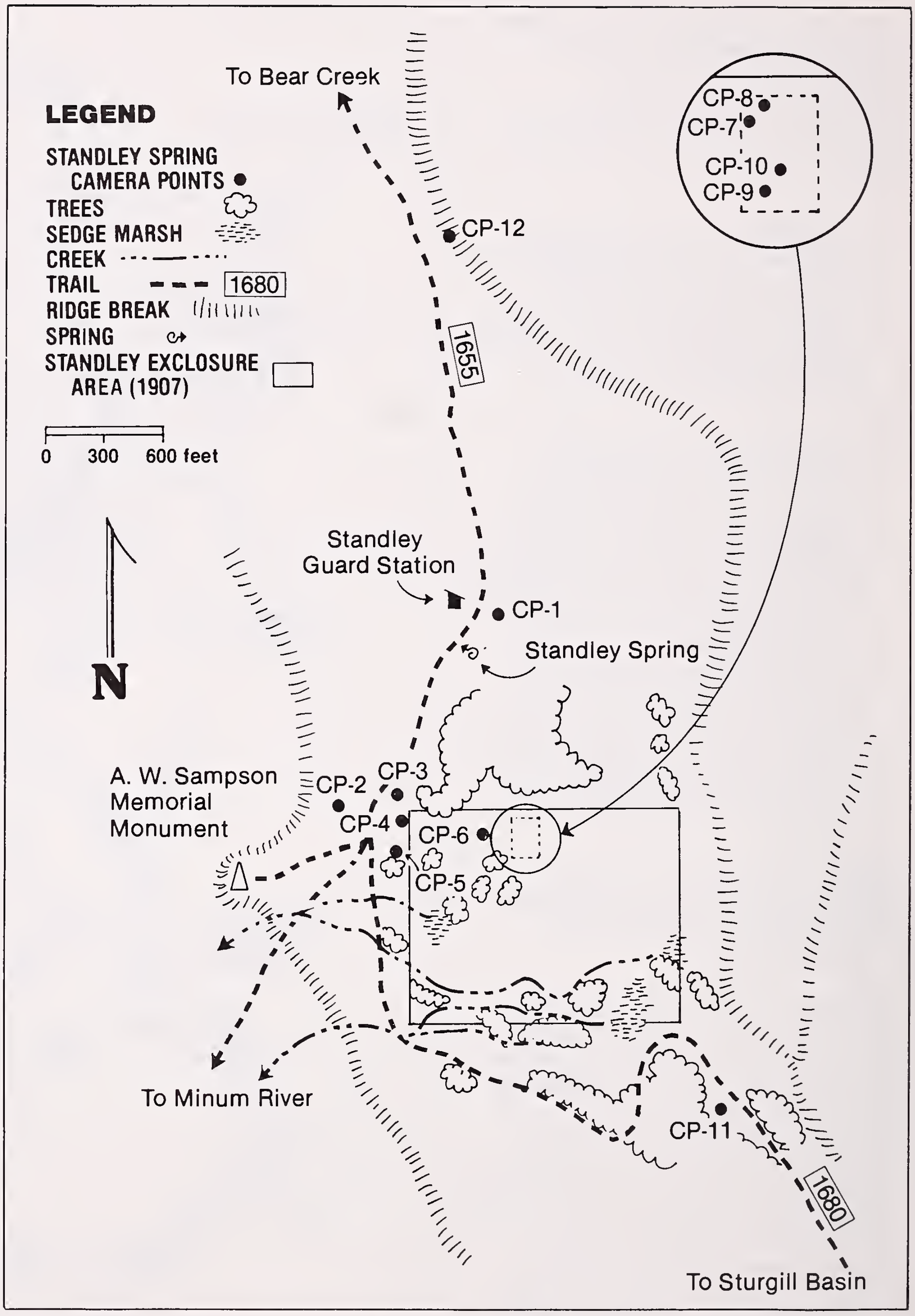

Figure 20. *Camera points (CP) at Standley Spring.*

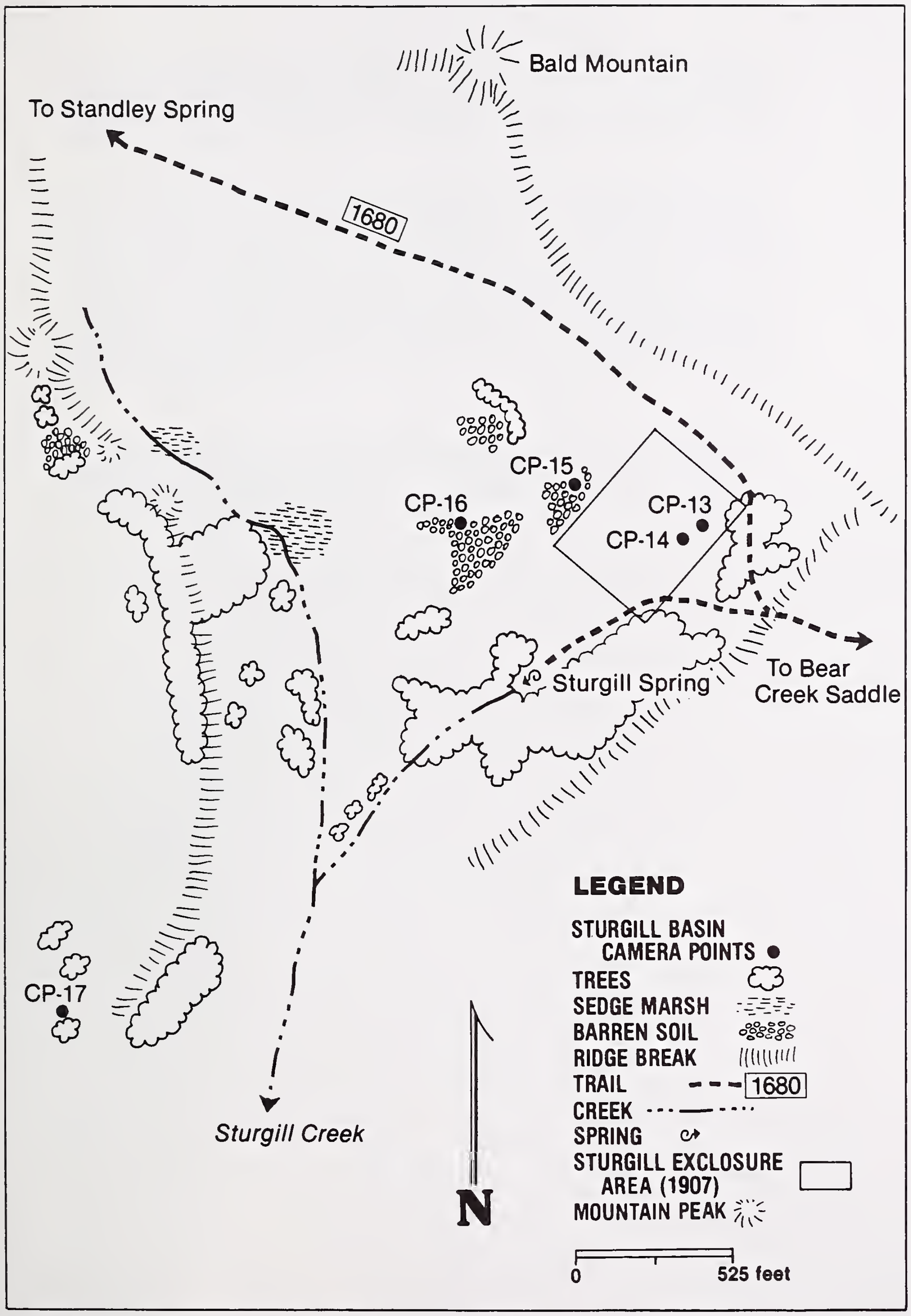

Figure 21. *Camera points (CP) at Sturgill Basin.*

Strickler, Gerald S., and Wade B. Hall. 1980. The Standley alottment: A history of range recovery. USDA For. Serv. Res. Pap. PNW-278, 35 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

One of the first range research programs on National Forest lands was done by Arthur W. Sampson in the Wallowa Mountains, Oregon, between 1907 and 1911. The historical perspective and the basic range management principles and practices developed from the studies are reviewed. Plant succession and range improvement from the depleted conditions prevalent in 1907 are discussed and documented by photographs between 1955 and 1976.

Keywords: Range management, history (range research), revegetation (range) succession, subalpine ranges, *Festuca viridula*, grazing damage.

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